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REMARKS/ARGUMENTS

Claims 1-7 and 9-25 are currently pending in the present application. No amendments have been proposed to these claims. All claims currently stand rejected over cited art, as set forth in greater detail below. Reconsideration of all claims is respectfully requested.

The Office Action refers to:

Lim et al:	"Laser assisted liquid film etching", Applied Physics Letters 62(25), 21 June 1993, pp 3345-3347
Russell et al:	US 5,266,532
Ikegami et al:	US 6,720,522
Yamazaki et al:	JP 59225896

Section 2 of the Office Action rejects claims 1, 2, 7 and 9-11 under 35 U.S.C. 102(b) as not new in the light of Lim et al. However, Lim et al. discloses only laser-assisted etching surface patterning of Si substrates (page 3347 col. 2) using a 514.5 nm (visible) HeNe laser and a condensed film of hydrofluoric acid over a polyvinyl alcohol coating. If etching is too deep, de-focusing of the laser beam is observed (page 3345 col. 2). Although the disclosure suggests that "There appeared to be no limit to the depth that could be etched", (page 3346 col. 1) the maximum etch depth actually obtained appears to be 2μ (Fig. 3). Etching does not begin until 1-10 min. after irradiation, which time is required for the laser beam to weaken adhesive forces between the polyvinyl alcohol film and the Si.

Applicant submits that there is therefore no disclosure in Lim et al of at least the following features of claim 1:

machining at least one of a through via structure and a through dice lane;

machining ... at the machining location with the laser beam, thereby causing the chemical reaction to take place at the machining location to form gaseous and solid particle by-products; and

venting the gaseous by-products from the environment of the liquid halide compound or the liquid comprising a mixture of halocarbons and other liquids and dispersing the solid by-products in the liquid halide compound or the liquid comprising a mixture of halocarbons and other liquids.

Applicant therefore submits that claim 1 is novel and inventive over the disclosure of Lim et al.

Since Lim et al discloses an etching cell into which a vapour is introduced which condenses on the substrate, we submit that there is no disclosure in Lim et al of providing an environment for a liquid halide as claimed in claim 2, but only for gaseous halide.

Although Lim et al disclose cooling of the substrate to form a condensed film thereon (Lim et al page 3345 col. 1) and maintaining the substrate at 15°C to maximise the etch rate (Lim et al page 3346 col. 1), there is no disclosure in Lim et al of controlling the temperature of the substrate to prevent thermal damage to the Si body or substrate, as claimed in claim 7. On the contrary, Lim et al teaches pre-baking the substrate at 120°C (Lim et al page 3345 col. 1).

Moreover, Lim et al appears to teach only the surface etching of Si, we submit there is no suggestion in Lim et al of machining a multilayer structure as claimed in claim 11.

Section 5 of the Office Action rejects claims 1-7, 9-14 and 16-18 under 35 U.S.C. 103(a) as lacking an inventive step in the light of a combination of Russell et al, Ikegami et al and Lim et al.

The Office Action avers that Russell et al discloses all the features of claim 1 except a liquid halide environment, directing the laser beam through the liquid halide and locally heating the liquid in the vicinity of the laser machining. The Office Action further suggests that Ikegami et al discloses directing laser beam through a liquid environment and that the substrate is covered by the liquid to remove heat and suppress the influence of vapour. The Office Action further suggests that Ikegami et al discloses a pump for removing dust and particles. Thus the Office Action avers that a combination of Russell et al and Ikegami et al discloses all the features of claim 1 except for a halide environment. The Office Action further states that Lim et al discloses the use of hydrofluoric acid for etching silicon so that, in the view of the Examiner, a combination of all three citations discloses all the features of claim 1.

Applicant submits that Russell et al discloses 248 nm (uv) laser-assisted mask-less etching of silicon devices in a non-corrosive gaseous halocarbon environment (Russell et al abstract, col. 4 lines 13-25). The disclosure has applications in pattern etching and backside thinning (Russell et al col. 4 lines 43-48, col. 5 lines 66-68). The excimer laser may promote a chemical reaction between the halocarbon ambient and a Si sample (Russell et al col. 4 line 49 – col. 5 line 5). Monolayers of Si are removed by a reaction between molten Si and halogen atoms and volatile by-products are pumped from the chamber (Russell et al col. 6 lines 7-16). Using the disclosed process it takes 90 minutes to etch 300 μ of Si using 100 Hz laser pulses (Russell et al col. 6 lines 58-60). Cooling is required to operate at higher pulse rates (Russell et al col. 6 lines 60-66).

Therefore Russell et al does not disclose at least the following features of claim 1:

machining at least one of a through via structure and a through dice lane;

providing an environment of a liquid halide compound or a liquid comprising a mixture of halocarbons and other liquids in at least a machining location;

directing the laser beam at the machining location ... in the environment of the liquid halide compound or a liquid comprising a mixture of halocarbons and other liquids;

locally heating the liquid ... with the laser beam in the vicinity of the machining location of the one of a silicon body and a silicon wafer substrate sufficiently to cause a chemical reaction between the one of a silicon body and a silicon wafer substrate and the liquid ...;

machining ... to form gaseous and solid particle by-products; and

venting the gaseous by-products ... and dispersing the solid by-products in the liquid ...

Applicant submits that Ikegami et al discloses machining a target surface by passing a laser beam through a liquid to process the target surface under the application of ultrasonic vibration (Ikegami et al col. 3 lines 19-25). In one embodiment the liquid is on the target surface (Ikegami et al col. 3 lines 31-33, col. 5 line 38 lines 4-5), preferably a wafer is immersed in the liquid (Ikegami et al col. 7 lines 2-3). The disclosure is particularly directed to patterning of a film on a substrate (Ikegami et al col. 3 line 43 – col. 4 line 9) using a 10 kHz Q-switch Nd YAG laser (Ikegami et al col. 5 lines 47-57). Any kind of liquid, such as water, ammonia solution (for Si) and glycerine hydrogen peroxide solution (for Cu) may be used in order to absorb heat generated by the laser beam, to reduce damage to the irradiated surface (Ikegami et al col. 7 lines 35-38) and suppress extent of vapour and bubbles generated by the irradiation (Ikegami et al col. 6 lines 51-67, col. 7 lines 29-31). The liquid is moved in a uniform flow across the surface (Ikegami et al col. 7 lines 12-14). In an embodiment ultrasonic vibration is applied to the target to shake dust and particles from the surface (Ikegami et al col. 8 lines 27-45). In an embodiment a wafer is partially diced by etching a 50 μ groove under water and then the wafer thinned from a backside to dice the wafer (Ikegami et al col. 8 line 56 – col. 9 line 20). A 100 μ deep trench may be etched using ammonia solution as the liquid at 10

mm/sec (Ikegami et al col. 10 lines 7-18). The etching of multilevel dielectric (Ikegami et al col. 11 lines 43-45) and metal films ((Ikegami et al col. 14 lines 9-16) is also disclosed.

Therefore, Applicant submits that a combination of Russell et al and Ikegami et al does not disclose at least the following features of claim 1:

machining at least one of a through via structure and a through dice lane;

providing an environment of a liquid halide compound or a liquid comprising a mixture of halocarbons and other liquids in at least a machining location;

directing the laser beam at the machining location ... in the environment of the liquid halide compound or a liquid comprising a mixture of halocarbons and other liquids;

locally heating the liquid ... with the laser beam in the vicinity of the machining location of the one of a silicon body and a silicon wafer substrate sufficiently to cause a chemical reaction between the one of a silicon body and a silicon wafer substrate and the liquid ...;

machining ... to form gaseous ... by-products; and

venting the gaseous by-products

Applicant submits that Lim et al discloses laser assisted liquid film etching for surface patterning of silicon using a combination of films of polyvinyl alcohol and hydrofluoric acid (Lim et al first paragraph) and a 514.5 nm (visible) laser (Lim et al page 3346 first full paragraph).

Therefore, Applicant submits that a combination of Russell et al, Ikegami et al and Lim et al does not disclose at least the following features of claim 1:

machining at least one of a through via structure and a through dice lane;

providing an environment of a liquid halide compound or a liquid comprising a mixture of halocarbons and other liquids in at least a machining location;

directing the laser beam at the machining location ... in the environment of the liquid halide compound or a liquid comprising a mixture of halocarbons and other liquids;

locally heating the liquid ... with the laser beam in the vicinity of the machining location of the one of a silicon body and a silicon wafer substrate sufficiently to cause a chemical reaction between the one of a silicon body and a silicon wafer substrate and the liquid ...;

machining ... to form gaseous ... by-products; and

venting the gaseous by-products

On the contrary, Applicant submits that, even if the disclosures could be combined, at best a combination of Russell et al, Ikegami et al and Lim et al would result, insofar as the disclosures are at all pertinent to claim 1, in the following:

248 nm (uv) excimer laser-assisted mask-less etching of silicon devices in a non-corrosive gaseous halocarbon environment for pattern etching and backside thinning in which the excimer laser may promote a chemical reaction between the halocarbon ambient and a Si sample, and in which volatile by-products are pumped from the chamber, by passing a laser beam through a liquid such as water, ammonia solution and glycerine hydrogen peroxide solution in order to absorb heat generated by the laser beam, to reduce damage to the irradiated surface and suppress extent of vapour and bubbles generated by the irradiation in which the liquid is moved in a uniform flow across the surface, in which the substrate is coated with a combination of films of polyvinyl alcohol and hydrofluoric acid.

This is clearly not the invention claimed in the present application.

Applicant therefore submits that claim 1 is novel and inventive in the light of any combination of Russell et al, Ikegami et al and Lim et al. Further, Applicant submits that similar considerations make it clear that independent apparatus claim 12 is also novel and inventive in the light of such a combination of the cited art.

The Office Action further appears to aver that a combination of Russell et al and Ikegami et al discloses all the features of independent apparatus claim 15 except a liquid chamber comprising a refrigerated liquid. However, the Office Action avers that Yamazaki discloses a silicon machining apparatus including a liquid Freon compound environment and therefore it would be obvious to use a refrigerated liquid such as liquid Freon for particle-free etching.

However, Applicant notes that Yamazaki states that the Freon liquid used is stable at room temperature and radical over 500°C (Yamazaki page 2). Moreover, the substrate and Freon are heated by a halogen lamp to 400°C (Yamazaki page 8). Therefore, there is no disclosure of refrigeration in Yamazaki.

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CONCLUSION

Claims 1-7 and 9-25 are currently pending in the present application. All claims have been initially rejected in view of specific cited references. In view of the arguments presented above, it is respectfully submitted that allowable subject matter has been defined in the pending claims and the Examiner is requested to reconsider all objections.

Accordingly, allowance of the subject application is earnestly requested. If the Examiner should have any queries, or should there remain any formal issues which can be addressed by Examiner's amendment in order to expedite the prosecution of the present application, the Examiner is invited to contact the undersigned.

Respectfully submitted,

By_____

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